SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES

PUBLISHED BY

N. D. C. HODGES,

47 LAFAYETTE PLACE, NEW YORK.

SUBSCRIPTIONS.—United States and Canada.....$3.50 a year.
Great Britain and Europe..... 4.50 a year.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

TORNADOES: A STORY OF A LONG INHERITANCE.[1]

AFTER illustrating the effects of a number of tornadoes by lantern-slides, the lecturer defined a tornado as a violent whirling storm of small dimensions, rapid progression, and brief duration, and then considered the origin of its destructive winds. Following the generally accepted theory that the tornado whirl is developed in a convectional up-draught, it was shown, by analogy with the eddy of water running from a basin by a vent at the bottom, that if tornadoes did not whirl, they would lose most of their violence. But they all whirl, and nearly all in the same direction,—from right to left. The general possession of so well-marked a feature implies that it has been inherited from some antecedent condition, and it was therefore asked, where are tornadoes formed? The records of the Signal Service leave no room for doubt on this point: tornadoes are nearly always formed in the south-eastern quadrant of the large cyclonic storms or areas of low pressure, so characteristic of our daily weather-maps, and to whose passage across the country we owe most of our weather-changes. The cyclonic storms are vast whirls, their winds sweeping over great spirals as they gradually approach the centre of low pressure, but generally without destructive velocity, at least on land. The spirals of our cyclonic storms universally turn from right to left, and in this motion we undoubtedly have the reason for the general right-to-left whirling of the tornadoes; for, when a little whirl springs up in a great whirl, the turning of the two will be in the same direction. This may suffice to show why tornadoes turn; but it may next be asked why cyclonic storms turn. An answer will be found by examining the region of their occurrence. They are developed in the belt of prevailing westerly winds, which, taken as a whole, form a vast whirl from right to left around the north pole. When the cyclonic disturbance arises in this polar whirl, it must turn in the same direction as the polar whirl turns; that is, again from right to left. Tornadoes may therefore be said to have inherited their habit of turning from their grandparent, the general circulation of the winds of the northern hemisphere around the north pole.

But why do the winds whirl around in this way? Why not the other way? Why do they whirl at all? The sun warms the air at the equator, while it is cooled at the poles; the expanded equatorial air flows away aloft north and south, and for this reason we should expect to find caps of high pressure around the poles; but it must be remembered that the interchange between equator and poles was established in an atmosphere that was already rotating with the earth on which it lay. It possessed this rotation along with the oceans in the youth of the earth, when all was still glowing and molten with heat; and it was only later on, when the earth had cooled somewhat, that the sun began to determine our climatic zones, and start an atmospheric circulation: hence, as the equatorial overflow runs poleward, it approaches the axis about which it rotates. In accordance with the principle of the conservation of areas, it must take on a whirl around the pole from west to east, or, as the North Star would say, from right to left; and this whirl is so much faster than the rotation of the earth that the high pressure expected at the poles as a result of low temperature is reversed into low pressure, due to excessive centrifugal force. We thus learn that the prevailing winds whirl around the pole because they had a way of turning with the earth; that the cyclonic storms possess a spiral circulation from right to left because they are formed in a whirling atmosphere; and that the tornadoes whirl because they are generated in whirling cyclones.

But why does the earth rotate? On inspecting the planets of our system, we find that rotation appears to be a common characteristic of all. The sun, the moon, Mars, Jupiter, and Saturn all turn one way, these being the only bodies of our system whose direction of rotation has been surely observed. Moreover, they all turn on their axes in the same way as they revolve around the sun in their orbits. Saturn's rings turn in the same direction. Let us imagine what would happen if these rings were clotted somewhat at a certain point: the parts behind the clot would be hurried on, and thus gaining a greater orbital velocity, and consequently a greater centrifugal force, would tend to pass outside of the clot; the parts ahead of the clot would be retarded, and, thus losing some of the centrifugal force that they had before, would be drawn by the planet somewhat inside of the clot; the parts outside of the clot would be drawn inwards, and, thus approaching the centre of their orbital revolution, they would be accelerated, and would tend to run ahead of the clot; while the parts on the inside of the ring would be drawn outwards, and would lag behind the clot. All these parts thus conspire to set up a whirling around the clot as a centre, still maintaining their orbital motion around Saturn. As a result, when all the matter of the rings is concentrated at the clot, it will form a mass possessed of an axial rotation; and this rotation will be in the same direction as its orbital revolution. It has therefore been supposed that the planets once existed as rings around the sun; that the rings were not so evenly balanced as are those of Saturn, which survive as rings even to this day; and that the planetary rings gradually coalesced into rotating balls, and thus gained their community of rotation. And yet why should the planetary rings have all rotated the same way? For no reason, unless they inherited their movement from a common ancestor. This ancestor is thought to have been a vast nebula, whose inward spiral falling together gradually produced the rings, all turning one way around the great central mass, which later formed the sun. But why did the nebula turn around? Why did its parts not simply fall together in radial lines? Because the nebula came from chaos, and we must not imagine that chaos possessed so specialized an arrangement as no motion, or as precisely such motions as would neutralize all tendency to rotation while its parts were falling towards their common centre of gravity. Any thing but this in chaos. There must have been motions of all kinds, and, their resultant being unbalanced with respect to their centre, they necessarily developed a whirl as they coalesced into the primeval nebula; and this whirl, through rings, planets, winds, cyclones, and tornadoes, has never been lost.

It is not simply to the imagination that we must trust for our realization of these past stages of our history. The sun, being vastly larger than the earth, still retains a glowing temperature, such as the earth has long since lost. Saturn's rings, evenly balanced, marvellous examples of retarded development, illustrate a stage long out of date with the unevenly arranged rings of the planets. Most of the nebulæ of the distant sky are still in the chaotic stage; but the great nebula of Andromeda, when finely photographed, shows a series of incurving spirals, such as the North Star saw in our nebula so long ago. It is the inheritance of this early habit that makes our tornadoes whirl.

[1] Abstract of a lecture before the Johns Hopkins University Travellers' Club, Jan. 27, 1891, by Professor William Morris Davis of Harvard University.